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JANUARY, 1918

Studies in the genus Lupinus—II. The Microcarpi, exclusive of Lupinus densiflorus

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(WITH SIXTEEN TEXT FIGURES)

INTRODUCTION

The subgenus *Platycarpos* of Watson readily permits separation into two groups, the *Pusilli* of Heller (Muhlenbergia **8**: 87. 1912), or the loosely-flowered small species of the interior of western North America; and the *Microcarpi* (Bull. Torrey Club **44**: 405. 1917), or the verticillate and commonly larger plants of the Pacific Slope of both North America and central Chile.

The published names applied to members of the *Microcarpi* are as follows:

L. microcarpus Sims, Bot. Mag. **50**: *pl. 2413*. 1823.
L. densiflorus Benth. Trans. Hort. Soc. II. **1**: 409. 1835.
L. Menziesii Agardh, Syn. Gen. Lup. 2. 1835.
L. palustris Kell. Proc. Cal. Acad. Sci. **5**: 16. 1873.
L. Menziesii aurea Kell. *ibid.* **5**: 16. 1873.
L. lacteus Kell. *ibid.* **5**: 37. 1873.
L. luteolus Kell. *ibid.* **5**: 38. 1873.
L. Bridgesii Gray; Watson, Proc. Am. Acad. **8**: 538. 1873.
L. malacophyllus Greene, Pittonia **1**: 215. 1888.
L. ruber Heller, Muhlenbergia **2**: 75. 1905.
L. arenicola Heller, *ibid.* **2**: 75. 1905.
L. horizontalis Heller, *ibid.* **2**: 74. 1905.
L. glareosus Elmer, Bot. Gaz. **39**: 53. 1905.
L. subvexus C. P. Smith, Bull. Torrey Club **44**: 405. 1917.

[The BULLETIN for December (**44**: 535–579. *pl 25, 26*) was issued December 27, 1917.]

L. Bridgesii Gray is evidently the same as *L. luteolus* Kell. and is so acknowledged by Watson (Bib. Index 238). *L. arenicola* has been referred by Heller (Muhlenbergia **6**: 70) to *L. lacteus* Kell., which, as noted by Heller, was referred by Watson first to *L. densiflorus* and later to *L. microcarpus*. *L. malacophyllus* Greene might easily be considered as a connecting link between the *Pusilli* and the *Microcarpi*. Since so many variations occur, it is really surprising that no more names have been published. Several specimens have been marked "var." by the collector or student; but evidently no one has cared to attempt a critical study of the group. Except for the material easily determined as *L. luteolus* Kell., most specimens have been labeled either *L. microcarpus* or *L. densiflorus*, or left unnamed.

During four years of field observations in middle western California, my efforts to determine the variations I collected led to unsatisfactory results, and a survey of the material found in the herbaria visited in 1908 brought me to the determination to some day seek a classification that might possibly eliminate some of the evident confusion as to proper identifications. With this object in mind, I recently undertook to look into the status of the forms already described, and then to work out the relationships and characters of the seemingly undescribed forms known to me.

MATERIAL EXAMINED

The National, Stanford University, and University of California herbaria kindly placed many sheets in my hands for study. Two weeks were spent in Cambridge, New York, and Philadelphia, where the material in the herbaria in those cities was given due attention. Thus some 225 sheets have been considered in forming the opinions put forth in this paper.

GEOGRAPHICAL DISTRIBUTION

This group is peculiar to the west coast of America, the range generally ascribed to the initial species, *L. microcarpus* Sims, being the range of the entire group. In South America, the plants seem to be confined to central Chile, having an altitudinal distribution from the coast far up into the Andes. In North America the longitudinal range is from Vancouver Island to Lower California;

Vancouver and the adjacent islands have one isolated form, the Yakima Valley in Washington another. This latter, one local form of central Oregon, and one of western Nevada are the only ones peculiar to the country east of the Cascade-Sierra ranges. The more widely distributed form northward is apparently common both to the waterways in Oregon east of the Cascades and also to southwestern Oregon and the northern counties of California. Central California is evidently the center of distribution of the group, and there many specialized and localized forms occur, from the coast well up into the Sierras.

DIAGNOSTIC CHARACTERS

Most of the characters ascribed by Sims and Bentham to their species are common to all members of the group, and cannot be used to distinguish between the two species. Agardh's treatment of the species was mainly based upon the specimens seen by him in Lindley's herbarium. A small-flowered plant collected by Douglas in California, as well as all the Chilean material there, he referred to Sims's species. A more robust and longer-haired plant he accepted as Bentham's *L. densiflorus*, and this he acknowledged as having the aspect and nearly all the characters of *L. microcarpus*,

> sed robustior et villo longiore praecepue in partibus floribus obsitus. Ceterum petioli longiores, verticilli densiores floresque albescentes videntur. Unica autem differentia, quae ad speciem distinguendam valere videatur, e bracteis sumenda est.

The yellow-flowered, short-pubescent form with long racemes of distinct verticels was set apart as his *L. Menziesii*. Three certain forms collected by myself in California were very readily determined as these three species of Agardh; but when I considered other forms found by me, the original plates of *L. microcarpus* and *L. densiflorus*, and also the conflicting determinations and opinions of various botanists, it seemed logical to conclude that the group needed special attention.

Upon taking up the study, I soon found that reliable diagnostic characters are not as readily selected as I expected them to be. Many which at first recognition appeared to be all-sufficient for clear-cut distinctions finally suffered complete or partial abandonment after being carefully weighed. As a rule, the general aspect will appeal to the eye first and the general structure of the vegetative parts of the plant merits reasonably close attention. Evidently the environment, and especially competition with plants of other genera, has much to do with whether the plant is low or tall Presumably the amount of available plant food may determine whether the plant is acaulescent and unbranched, or more or less caulescent and branched. The axial terminal bud, unless injured by some external cause, may be depended upon to produce a fruitful peduncle. Branching is, of course merely the result of the development of axillary buds, and it is common, in large well-branched plants, to find matured or ripened seeds in the pods of this axial peduncle when the racemes of at least some of the branches are still in bloom. A low unbranched acaulescent plant is a record of its own environment, and a dry barren hillside or desert area the habitat in which it is able to both exist and persist On the other hand, a tall plant, branched more or less above the base perhaps, almost always comes from an environment also favorable to plants of other genera; and abundance of nourishment, assisted by the stimulation of competition, is fundamentally responsible for the extensive vegetative growth developed. The "fistulous" character, especially, is certainly the evidence of a rapid growth during a warm moist season. I see no "specific characters in the stem structures of these plants, excepting, to some extent, in *L. luteolus* Kell.; but I have admitted into my treatment of varieties more than one definite reference to such stem characters, especially when coupled with other characters or supported by geographical distribution. The length of the petioles and the size of the leaflets and stipules vary with the stem portions and seem to me to be of no value for specific distinctions. Even the pubescence failed to give satisfaction in my effort to draw specific lines.

Most reliable of all, I have concluded, is the position of the flowers in anthesis and soon after anthesis. This may not always be strictly constant in all the flowers of a particular raceme, nor in all the racemes of a certain plant; but I am convinced that, with occasional allowance here for some little variation, this character will prove to be as positive a one as can be found in the *Microcarpi*, and certainly is more usable than the very indefinite distinctions as yet proposed by those who have treated any of the group. The verticels are regularly crowded in *L. luteolus* and *L. horizontalis*, usually well separated in *L. microcarpus* and *L. subvexus;* but in *L. densiflorus* is found a full range of variations from densely crowded to quite remote. The floral bracts vary much in length, usually becoming reflex-withering as the flower-buds open; but in one variety of *L. subvexus* they are rather conspicuous for their tardiness in reflexing. Their length seems to be too inconstant to be of much diagnostic value.

With few exceptions, I have not been able to accept size and color of petals for specific distinctions, though such are abundantly used in the varietal characterizations. At the free edges above, the keel petals are usually ciliate, often densely so, and a tendency to be ciliate at the free edges below is more or less pronounced in a few of the forms herein designated as varieties; but in *L. luteolus* this ciliation below is as dense and prominent as that above, usually extends backward onto the claws, and seems to be worthy of special notice. Variation in size, shape, apex and base of banner; ciliation, length, and width, but not detailed form, of wings; size, shape, and curvature of keel—are all worthy of consideration in the delineation of varieties. The pubescence of the calyx usually agrees rather closely with that of the peduncles, petioles, etc. The lower lip, I am persuaded, yields good varietal characters as to length, dentation, and inflation; but the upper lip, at least in many cases, varies too much within the flowers of a given raceme to be trusted for any distinctions. The presence or absence of bracteoles is usually a decided uncertainty; but their presence may be diagnostic in *L. horizontalis* and in Elmer's *L. glareosus*.

The size, relative thickness, surface, color, and marking of the seeds—when more of same have been collected and properly identified—will probably be found of value in the varietal, if not in the specific, classification; but in *L. luteolus* again, I find a seed character seemingly distinctive and peculiar to that species. The mature pods show much variation in size, but otherwise give little evidence of deserving much consideration.

PATHOLOGICAL MATERIAL

Abnormal specimens are occasional, and care should be exercised to avoid them in the designation of varieties. Field work may sometimes be necessary in order to establish that a certain variation is really the result of a diseased condition. Usually, however, an abnormal development is indicated by pronounced elongation or multiplication of some of the floral parts. One very interesting case is that represented by sheet 366288 in the U. S. National Herbarium (*K. Whited 536*, Ellensburg, Washington). In both specimens the flowers dissected have three wing-petals each, and in one all the wing- and keel-petals are very abnormal in shape (FIG. 1). In the case of sheet 620193 (*V. Bailey 91*, Toppenish, Washington) the flowers are of the same narrow form and seemingly fruitful.

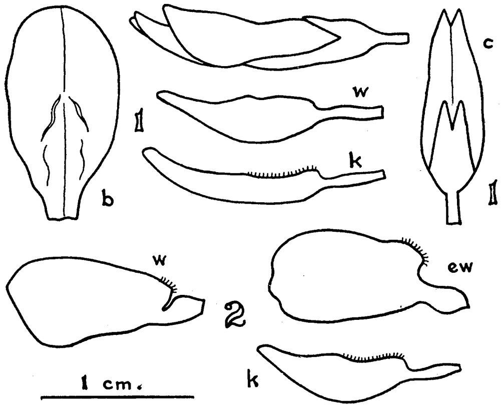

FIG. 1. LUPINUS SUBVEXUS FLUVIATILIS C. P. Smith. *K. Whited 536* (US 366288). 1. From specimen on right, *b*, banner; *w*, wing (three like this); *k*, keel; *c*, calyx as seen from above; side view of entire blossom above. 2. From specimen on left: *w*, wing (two like this); *ew*, extra wing petal; *k*, keel; no banner present.

SPECIAL ABBREVIATIONS

The location of each specimen cited is indicated by an abbreviation. The abbreviations used are as follows:

DS, Dudley Herbarium of Stanford University;
UC, herbarium of the University of California;
ColU, herbarium of Columbia University;
T, Torrey Herbarium (at New York Botanical Garden);
NY, herbarium of the New York Botanical Garden;
G, Gray Herbarium of Harvard University;
US, United States National Herbarium;
PA, Philadelphia Academy of Arts and Sciences;
CPS, private herbarium of the writer.

ILLUSTRATIONS AND MEASUREMENTS

The figures are mere outline representations of the dissected floral parts, mounted in water under cover-glass slips. The calyx is represented as seen from above, the upper lip having been pressed down to show its proportional relations to the lower lip. By this method, the interstitial bracteoles, if present, are not apt to be overlooked. One wing-petal is often added merely to show the extent or absence of the ciliation. The banner is flattened out sufficiently to get the measurements and show the shape of the apex and claw. The measurements, with necessary exception in a very few cases, were made from these dissected floral parts after same had been softened in boiling water and mounted for drawing.

Key to the species of the Microcarpi

- Bracts subulate throughout, mostly stiff and not reflex-withering, about 5–6 mm. long, little more than twice the length of the pedicels; flowers 9–11 mm. long. 1. *L. malacophyllus.*
- Bracts linear-lanceolate with a dilated thin base, mostly reflex-withering as the flower-buds open, at least the lower much longer than the pedicels; flowers 11–19 mm. long.
  - Flowers ascending to suberect in anthesis.
    - Banner 4–6 mm. wide; wings naked below and often above; calyx ebracteolate. 2. *L. microcarpus.*
    - Banner 7–11 mm. wide; wings and keel ciliate near the claw both below and above; calyx bracteolate. 3. *L. horizontalis.*
  - Flowers spreading in anthesis.
    - Flowers soon becoming suberect after anthesis, not secund. 4. *L. subvexus.*
    - Flowers spreading or distinctly secund after anthesis.
      - Plants 30–90 cm. tall, strictly fibrous, often widely branched above; banner ovate; keel densely ciliate at base both below and above; verticels crowded; seeds uniformly blackish brown, regularly tuberculate. 5. *L. luteolus.*
      - Plants 4–50 cm. tall, stems short and fibrous or elongated and fistulous; banner elliptic to oval, rarely ovate; keel usually naked near base below; but sometimes sparsely ciliate; verticels crowded or remote; seeds smooth or irregularly roughened. 6. *L. densiflorus.*[*]

1. LUPINUS MALACOPHYLLUS Greene, Pittonia **1**: 215. 1888.

I quote from the original description as follows:

> Annual, erect, a span high, with a few ascending branches from the base; soft throughout, with a long white villous pubescence . . . . racemes verticillate, at

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[*] *L. densiflorus* and its varieties will be discussed in the third paper of this series.

least below, . . . calyx-lips very unequal; the upper short, scarious, slightly notched; lower . . . distinctly 3-toothed: corolla ½ inch long, light blue and dark purple; keel moderately falcate, naked . . . seeds orbicular, white.

Dry hills, near Verdi, Nevada, 2 May, 1888; collected by Mr. C. F. Sonne . . . related to the homely small-flowered *L. pusillus* and *L. brevicaulis*, but with . . . showy verticillate racemes of large flowers, ..."

This species might well be viewed as a connecting link between the *Pusilli* and the *Microcarpi*. Its possession of verticillate flowers is my only excuse for referring to it in this paper. Forms of *L. subvexus transmontanus*, of northern California and Oregon, are the only specimens of the *Microcarpi* that have already been, and may yet be expected to be, confused with *L. malacophyllus*. Seeds in my collection, collected by Heller, from about Reno, are from pale flesh-color to dark reddish.

NEVADA. Without definite locality, *C. L. Anderson* (UC 170306). Ormsby County: Carson City, 1865, *C. L. Anderson* (UC). Washoe County: along track below Verdi, 16 May, 1897, *C. F. Sonne* (UC); same locality, June, 1889 (UC); Reno, 13 May, 1901, *T. W. Cowgill* (UC); seed only, road between Laughten Springs and Reno, 26 July, 1911, *K. Brandegee* (UC).

2a. LUPINUS MICROCARPUS Sims, Bot. Mag. **50**: *pl. 2413*. 1823. [FIGS. 2, 3.]

The original description is as follows:

Lupinus microcarpus; foliis digitatis, calycibus verticillatis in appendiculatis: labio superiore emarginato inferiore bifido ter breviore, leguminibus rhombeis hirsutis dispermis.

Descr. Stem branched. Leaves digitate: leaflets 9–10, lanceolate, hairy on the under surface, smooth on the upper; petioles twice the length of the leaflets, pubescent. Stipules subulate. Peduncle terminal. Flowers blue, in a verticillate spike:whorls six-flowered. Bracts small, hairy. Calyx inappendiculate (unless the bracts, which are distinct from the calyxes, are to be called the appendices) bilabiate; upper lip much the shortest, emarginate; lower lip bifid. Vexillum oblong. Alae equalling the vexillum. Carina monopetalous, sharp-pointed. Anthers 10, five oblong, and five orbicular. Style the length of the stamens. Stigma capitate. Legume small, rhomb-shaped, mucronate by the persistent style, hairy; seeds two, variegated with black lines and dots.

This species of Lupin is a native of Chili. It has not, we believe, been heretofore described; and differs from all the known species by its small two-seeded pods. We regret however that we did not receive these in time enough to be added to the engraving.

Raised from seeds by John Walker, Esq., of Arnos Grove. It flowered in April, and appears to be annual.

Authors generally, following Agardh, seem to have assumed that any and all Chilean specimens are necessarily *L. microcarpus* Sims. One of my early hypotheses was that the Chilean plant ought to be specifically distinct from all the North American forms referred to this species of Sims. As I now see it, however, neither of these assumptions is altogether in agreement with the facts. A new viewpoint is evidently necessary and the conclusions finally accepted by me are: (1) that the strongest specific character possessed by *L. microcarpus* has never been properly recognized; (2) that most of the North American forms regularly, or occasionally, referred here belong rather to two other species; and (3) that both of these "two other species" are likewise represented in Chile. This viewpoint, as I see it, permits a much more satisfactory classification of the forms under consideration.

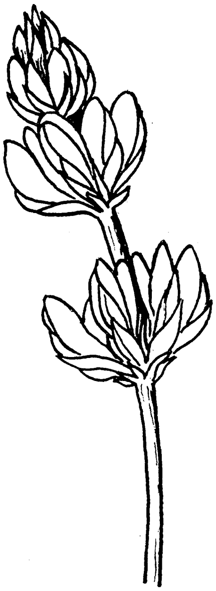

FIG. 2. LUPINUS MICROCARPUS Sims. Copied from original plate.

The original description serves little more than to indicate the group, of which this species was the first named and described. The illustration (from which FIG. 2 was copied) shows quite plainly, however, that the flowers must have been ascending to suberect in anthesis, a character that, as stated above, my studies have led me to accept as of real diagnostic value. This character, I am persuaded, will be found to persist under cultivation, at least for a few generations. I find, moreover, amongst the very limited array of Chilean material available for my study, specimens which show this character and which certainly, it seems to me, represent much better the form used for the original illustration than the other Chilean specimens referred elsewhere by myself, or the North American specimens referred here by others. It is very probable that the species, as here limited, is a composite of more than one recognizable form; but I await the opportunity to study new and additional material before attempting to do more with the South American varieties.

CHILE. Vicinity of Santiago, springy hillsides, 4500 ft., near Rio Colorado, 21 Jan., 1902, *G. T. Hastings 468*; without definite locality, *C. Gay*, ex Herb. Mus. Paris (G); Coquimbo, July–Aug., 1856, *W. H. Harvey* (G).

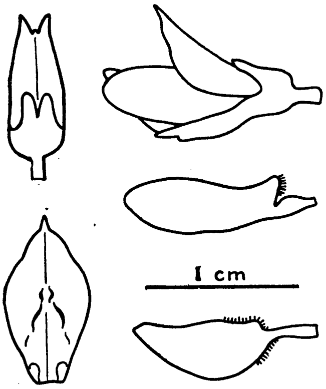

FIG. 3. LUPINUS MICROCARPUS Sims. *G. T. Hastings 468* (UC 65806).

FIG. 3 represents the floral characters of Hastings' No. 468, as recorded above. The specimen may be briefly described as follows: about 15 cm. tall, branches and foliage congested; villous, branched near the base and rebranched above; leaflets about 10–15 mm. long, petioles 50–70 mm. long; flowers ascending to suberect in anthesis; verticels 2–3; legumes 13–15 mm. long, seeds about 5 x 4 mm., straw-colored, unmarked, perhaps immature.

The species is represented in North America by the following variety:

2*b*. **Lupinus microcarpus ruber** (Heller) comb. nov. [FIG. 4.]

Lupinus ruber Heller, Muhlenbergia **2**: 73. 1905.

From Heller I quote:

> Branched from the base, the branches diffuse . . . leaflets blue-green . . . smooth above . . . : flowers erect in from 2 to 4 whorls, . . . dull red, 1 cm. long, about 4 mm. across: . . . lower calyx lobe 8 mm. long, barely 3 mm. wide at the base, the apex cleft for 2 mm., with a short cusp in the sinus; upper lip practically obsolete, represented by two short lanceolate teeth of 1 mm.: banner almost plane, ovate-lanceolate, 4 mm. wide at base, slightly keeled; wings narrow, 2 mm. wide, the lower edges not meeting until near the apex; keel not strongly curved, barely 2 mm. wide at the middle, bearded only near the slightly narrowed base. . .
>
> The type is no 7827, collected May 5, 1905, at Tehachapi, Kern County, California, along the railroad a short distance west of the town. It is a species remarkable for its small narrow red flowers. Some of the specimens show only a short central flowering branch much shorter than the leaves, while others have in addition lateral branches about equalling the leaves. It is a relative of *L. brevicaulis*, but that has "deep blue" flowers, the parts all but the keel differing in shape, and that is glabrous, while in ours it is bearded near the base.

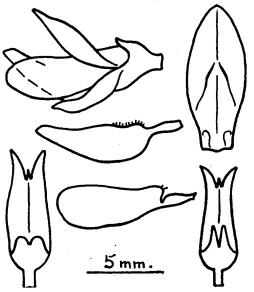

FIG. 4. LUPINUS MICROCARPUS RUBER (Heller) C. P. Smith. *K. Brandegee* (UC 149863).

The calyx is mostly 7–9 mm. long, the teeth of the lower lip are about 1.5 mm. long, commonly slender and curved-diverging, and the interstitial "cusp" is conspicuous. The flowers vary from dark red to merely pinkish. The seeds are yellowish gray to flesh-color, about 3.5 mm. x 3 mm., flattish, coarsely rugose, unmarked or nearly so. *L. brevicaulis*, with which Heller compares the plant, is a member of the *Pusilli*.

CALIFORNIA. Kern County: Tehachapi, 5 May, 1905 *A. A. Heller 7827* (US, PA, NY, G); Tehachapi, June, 1911, *K. Brandegee* (UC). San Diego County: Jacumba Hot Springs, near Monument No. 233, 26 May, 1894, *L. Schoemfledt*, U. S. & Mex. Int. Bound. Comm. No. 3307 (US); same locality, 29 May, 1894, *E. A. Mearns*, U. S. & Mex. Int. Bound. Comm. No. 3336 (US); Banner, 25 Mar., 1901, *T. S. Brandegee* (UC); Jacumba, 2500 ft., 9 July, 1916, *E. A. McGregor 88* (CPS). San Bernardino County: Mesas, Argus Mountains, Apr.–Sept., 1897, *C. A. Purpus 5437* (US, G, UC). ?San Luis Obispo County: La Panza, 26 May, 1888, *Mrs. Mathews* (UC).

3*a*. LUPINUS HORIZONTALIS Heller, Muhlenbergia **2**: 74. 1905. [FIG. 5.]

I quote from the original description, as follows:

> Branches several, all floriferous . . . the lowest ones horizontal, the ones above them more ascending, the middle ones erect . . . lower lip of calyx green, pubescent with somewhat tangled hairs, ovate-lanceolate, 6 mm. long, over 3 mm. wide at base, barely acutish, the apex minutely 2-toothed; upper lip ovate, membranous, barely 2 mm. long, cleft nearly to the base, the lobes lanceolate with rather wide sinus. villous and ciliate: flowers pale violet-blue, whorled and crowded . . . erect, 1 cm, long, 7 mm. across; banner plane or only slightly turned back, with a prominent midvein; wings . . . 2 mm. wide . . . keel not much curved, ciliate on the lower third . . . seeds nearly 3 mm. across marked with small dark spots.

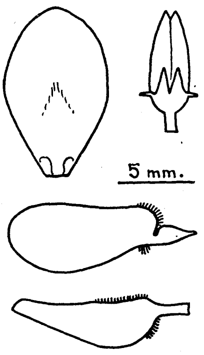

FIG. 5. LUPINUS HORIZONTALIS Heller. *A. A. Heller 7725* (G).

I accept this as a well-marked species. It is probably peculiar to the region of the type locality, though represented southeastward by a distinct variety.

CALIFORNIA. Kern County: Sunset, 20 Apr., 1905, *A. A. Heller 7725* (US, PA, G, NY).

3*b*. **Lupinus horizontalis platypetalus** var. nov. [FIG. 6.]

A *L. horizontali* differt partibus omnibus florum majoribus latioribusque; vexillo 15 x 11 mm., alis 15 x 7 mm., carina 12 x 4 mm.; calyce 9 mm. longo; ramis exterioribus specie non prostratis; seminibus prope 3.5 x 3 mm. crassis.

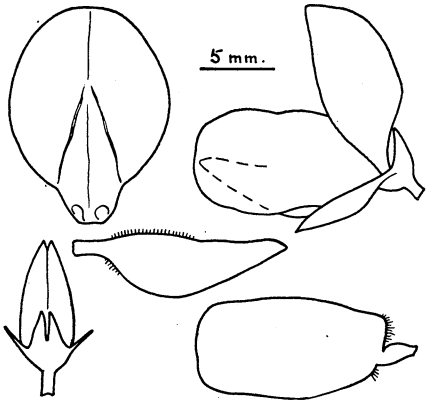

FIG. 6. LUPINUS HORIZONTALIS PLATYPETALUS C. P. Smith. *Hall & Chandler 6860* (UC 127296).

All the floral parts are much larger and broader than in the typical form of the species, and the outer branches are apparently not prostrate. The seeds are of a buff ground, marbled with purplish brown.

CALIFORNIA. San Bernardino County: eastern base of Fremont's Peak, Mojave Desert, 6 May, 1906, *Hall & Chandler 6860* (TYPE, UC 127296); Mojave Desert, May, 1882, *S. B. & W. F.Parish 1271* (G). Kern County: near Randsburg, May, 1913, *K. Brandegee* (UC).

Platypetalus is Greek for "broad petal."

4*a*. LUPINUS SUBVEXUS C. P. Smith, Bull. Torrey Club 44: 405. 1917. [FIG. 7.]

The following is a part of the original description:

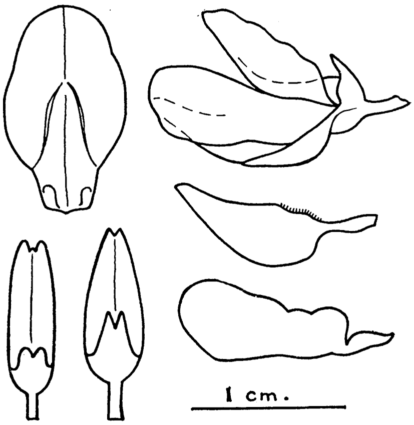

FIG. 7. LIPINUS SUBVEXUS C. P. Smith. *Heller & Brown 5415* (DS 9586).

> Simple or branched, loosely villous, the hairs 2–4 mm. long; whorls 3–7, well- separated; flowers spreading in anthesis, evidently ascending to suberect later; calyx ebracteolate, quite villous below; pods not secund. The typical plant has the lower lip of the calyx evidently inflated (subsaccate) near the base, large flowers with much of the banner and wings dark purple, and the banner rounded apically. Most of the varieties have the lower calyx-lip scarcely or not at all inflated and smaller flowers with the banner gradually narrowed to an acute apex.

CALIFORNIA. Yolo County: Madison, *Heller & Brown 5415* (DS, US, PA, NY, G). Contra Costa County: Antioch, 3 May, 1894, *A. Eastwood* (G, UC); Antioch, 8 Apr., 1895, *A. Eastwood* (US); Clayton, 17 Apr., 1889, *Chesnut & Drew* (UC). Alameda County: Oakland Hills, 1866, *H. N. Bolander 100* (G); Alameda, *T. S. Brandegee* (DS 9589); Livermore Pass, May, 1898, *J. B. Davy* (UC); Cedar Mountain, May, 1903, *A. D. E. Elmer 4371* (US, NY). San Francisco County: San Francisco, Apr., 1893, *I. Tidestrom* (UC).

Most, if not all, of these specimens are labeled *L. microcarpus* Sims, though the type sheet bears a correction, by A. A. H., changing the determination to *L. densiflorus* Benth.

Subvexus, "sloping upward," refers to the position assumed by the flowers upon withering.

Key to the varieties of Lupinus subvexus

- Calyx 9–11 mm. long.
  - Banner truncate, rounded, or obscurely angled at apex, usually 7–8 mm. wide.
    - Bracts normally reflex-withering as the flower-buds open.
      - Flowers 14–17 mm. long; calyx 10–11 mm. long; leaves not blackening in drying. 4*a*. typical *subvexus*.
      - Flowers about 14 mm. long; calyx 9 mm. long; leaves blackening in drying. 4*b*. var. *nigrescens*.
    - Bracts tardily or not at all reflex-withering. 4*c*. var. *fluviatilis*.
  - Banner evidently angled at apex, 5–7 mm. wide.
    - Wings usually non-ciliate; keel naked below.
      - Verticels approximate; plants 8–18 cm. tall, bushy. 4*d*. var. *transmontanus*.
      - Verticels remote; plants 20–40 cm. tall, with stems and branches elongated and fistulous below. 4*e*. var. *Leibergii*.
    - Wings strongly ciliate near base above; keel ciliate below. 4*f*. var. *insularis*.
- Calyx 7–8 mm. long; banner 5–6 mm. wide, angled at apex.
  - Leaflets 20–40 mm. long, 7–10 mm. wide, green; banner 9–11 mm. long.
    - Verticels distinct; keel straight. 4*g*. var. *phoeniceus*.
    - Verticels crowded; keel evidently arcuate. 4*i*. var. *Wilkesii*.
  - Leaflets 10–20 mm. long, 4–6 mm. wide, conspicuously white woolly-villous; banner more slender, 12–14 mm. long. 4*h*. var. *albilanatus*.

4*b*. **Lupinus subvexus nigrescens** var. nov. [FIG. 8.]

A *L. subvexo* typico differt foliolis nigrescentibus cum siccantes; pilis brevioribus inconspicuuis; floribus paulo minoribus; labio inferiore calycis vix inflato; alis superne ad basin ciliatis.

Differs from the typical form in that the leaflets turn black in drying, hair-covering less conspicuous, flowers smaller, lower lip of the calyx but slightly subsaccate, and the wings ciliate above near the base.

CALIFORNIA. Ventura County: Griffins; Mt. Pinos, July, 1902, *A. D. E. Elmer 4006* (TYPE, US 466205; type-duplicates, DS, NY). Kern County: hills, near the summit of Tejon Pass, on desert slope, 27 May, 1914, *S. B. Parish 9256* (UC).

This variety merits special study in the field, with collection of considerably more material. It is very different from Elmer's *L. glareosus*, taken at the same locality, but shares with that variety the peculiar character of the leaflets turning black in drying. The specimens are labeled *L. microcarpus.*

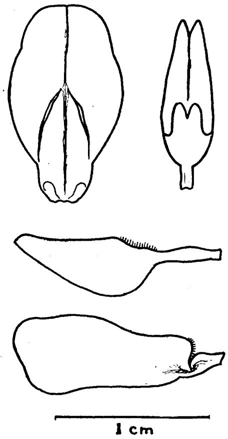

FIG. 8. LUPINUS SUBVEXUS NIGRESCENS C. P. Smith. *A. D. E. Elmer 4006* (US466205).

4c. **Lupinus subvexus fluviatilis** var. nov. [Fig. 9.]

Eramosus vel ramosus ad basin ramis suberectis vel pandentibus, 10–25 cm. altus, conspicue villosus; foliis paulo congestis cum planta humilis eramosaque est, plus patentibus cum planta ramosa est; pilis 1–1.5 mm. longis; petiolis 4–10 cm. longis, villosis, pilis saepe paulo plus 2 mm. longis; foliolis 5–10, 15–25 mm. longis, saepe obovatis vel spatulatis nonnumquam oblanceolatis, apice rotundatis vel angulatis, ciliato-villosis ad medio-costis marginibusque: pedunculis foliis plerumque brevibus; verticillis 3–5, plus minusve appositis; floris ad anthesin pandentibus, postea ascendentibus vel suberectis, 14–16 mm. longis; pedicellis paulo plus 1 mm. longis, plurimum gracilibus; bracteis verticilli humillimi calyce prope aequantibus longitudine, tarde vel nequaquam

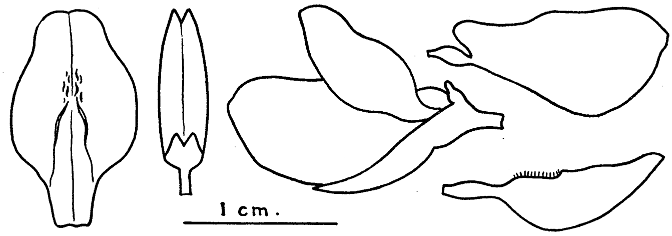

FIG. 9. LUPINUS SUBVEXUS FLUVIATILIS C. P. Smith. Fritillaria Club (US 205559).

reflectentibus et marescentibus, laxe villosis vel sublaevibus: calyce ebracteolato 9–10 mm. longo, subter dense villoso pilis prope 2 mm. longis, labio superiore diverso 2-dentato, prope 2 mm. longo, inferiore subrecto vel ad basin paulo inflato 3 mm. lato 2-dentato, sinu plerumque sine vestigio; corolla pallido-rosea vel-purpurea; vexillo 12–14 mm. longo, 7–8 mm. lato, apice paulo contracto, rotundato vel truncato, plus contracto ungue 2–4 mm. lato; alis 11–14 mm. longis, 5–7 mm. latis, ad basin non ciliatis; carina 9–11 mm. longa, subrecta: leguminibus usitatibus prope 14 x 8 mm.; seminibus pallidis maculatis, 4.5 x 4 mm.

WASHINGTON. Without definite locality, 1889, *G. R. Vasey 259* (TYPE, US 296664; type-duplicates, G, NY). Yakima County: Yakima region, 1882, *T. S. Brandegee 42* (UC); North Yakima, Oct., 1885, *T. S. Brandegee* (UC); Fritillaria Club, North Yakima, 1890, (US); Toppenish, 17 July, 1897, *V. Bailey 91* (US); Yakima, 3 June, 1898, *A. B. Leckenby* (US); North Yakima, 29 May, 1899, *J. B. Flett* (US); Wenas, 1 June, 1902, *Griffith & Cotton 85* (US, NY). Kittitas County: Ellensburg, 25 June, 1897, *K. Whited 536* (US); Ellensburg, June, 1897, *A. D. E. Elmer 371* (US, NY).

Seemingly peculiar to the valley of the Yakima River in central Washington. The flowers are relatively large with broad petals. Perhaps the strongest individual character is that the floral bracts are tardily or not at all reflex-withering as the flower-buds open. The seeds are flesh-color, mottled with a pale reddish brown, the hilum of the darker color. FIG. 1 illustrates abnormal specimens of this variety.

Fluviatilis is Latin for "of a river," and refers to the habitat.

4*d*. **Lupinus subvexus transmontanus** var. nov. [FIG. 10.]

A var. *fluviatili* differt foliolis oblanceolatis plerumque acutis; calyce 9–11 mm. longo, sinu labii inferioris plerumque dentis vestigio instructo; vexillo apice angulato, 11–12 mm. longo, prope 6 mm. lato ad basin paullatim contracto.

Similar to var. *fluviatilis*, but the leaflets are usually acute at the apex, the floral bracts usually reflex and wither as the flower-buds open, the lower lip of the calyx has the vestigial median tooth, and the banner is evidently acute at the apex.

OREGON. Wasco County: Antelope, May, 1885, *T. Howell* (TYPE, US 20844; type-duplicate, PA). County not given: Currant Creek, 11 May, 1885, *T. Howell 361* (G); John Day River, Crown Rock, 19 June, 1896, *V. Bailey 65* (US). Malheur County:

Malheur River, June, 1883, *Cusick 1113* (G). Jackson County: Antelope Creek, near Eagle, 4 June, 1898, *E. I. Applegate 2388* (US).

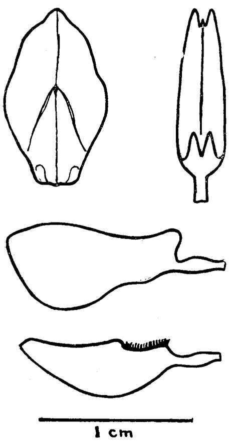

FIG. 10. LUPINUS SUBVEXUS TRANSMONTANUS C. P. Smith. *T. Howell* (US 20844).

CALIFORNIA. Modoc County: meadow bank along stream, 28 July, 1893, *Milo S. Baker* (UC); shore of Goose Lake, Aug., 1895, *Mrs. R. M. Austin* (US); sagebrush at Tule Lake, 31 May, 1897, *E. I. Applegate 879* (US); Goose Lake, July, 1898, *Mrs. R. M. Austin & Bruce 154* (UC). Lassen County: Craigs, 1893, *M. S. Baker* (UC); Madeline Plains, June, 1898, *Mrs. R. M. Austin & Bruce 2145* (DS, NY, UC). Siskiyou County: Klamathon, 2 July, 1903, *E. B. Copeland*, Baker Distribution 3537 (US, NY, G); Klamath Hills, 13 May, 1909, *G. D. Butler 704* (UC); Klamath Hills, 21 May, 1910, *G. D. Butler 1373* (US, UC).

Transmontanus is Latin for "across the mountains" and refers to the fact that the form is found on both sides of the Cascade ranges. It has been determined as *L. densiflorus*, *L. microcarpus*, and *L. malacophyllus*.

4*e*. **Lupinus subvexus Leibergii** var. nov. [FIG. 11.]

A var. *transmontano* differt altitudine 25–40 cm.; caule fistuloso ramoso aliquantum super basin; pedunculis ramisque elongatis: verticillis 4–5, distantibus; floribus suberectis mox post anthesin prope 13 mm. longis: bracteis mox marescentibus; calyce 2-dentato, 10 mm. longo, prope 3 mm. lato; vexillo 11 mm. longo, 5 mm. lato, apice acuto vel prope acuminato, ungue 4 mm. lato basi; alis 11 mm. longis; carina 8 mm. longa, recta.

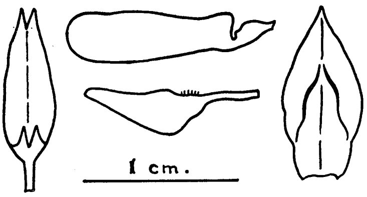

FIG. 11. LUPINUS SUBVEXUS LEIBERGII C. P. Smith. *J. B. Leiberg 317* (US 291134).

Unlike the other northern races of *L. subvexus*, this variety is branched from well above the base and has the lower parts distinctly fistulous. The verticils are remote, the banner is almost acuminate at the apex and its claw is poorly defined, and the

flowers are evidently far from being showy. It is probably very local and rare and should be carefully studied in the field.

OREGON. Crook County: near Prineville, 955 m. alt., 1894, *J. B. Leiberg 317* (TYPE, US 291134; type-duplicates, G, US 291133).

4*f*. **Lupinus subvexus insularis** var. nov. [FIG. 12.]

Ad basin ramosus; foliis aliquantum congestis, foliolis gracilibus 2–3 cm. longis; racemis pluribus, floribus ad anthesin pandentibus ascendentibus postea, bracteis reflectentibus, bracteis petiolis pedicellisque laxe villosis; calyce dense villoso; carina curva.

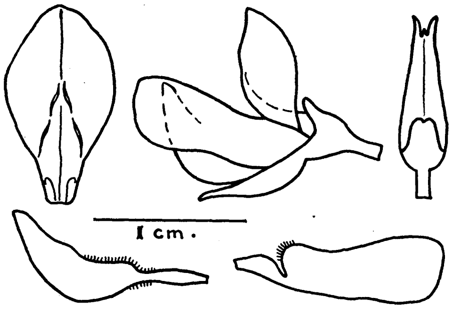

FIG. 12. LUPINUS SUBVEXUS INSULARIS C. P. Smith. *T. S. Brandegee* (UC 82003).

Much branched near the base, foliage congested, leaflets slender and 2–3 cm. long; racemes several with the flowers spreading in anthesis but ascending soon afterwards, bracts reflexing as the flower-buds open, the bracts, petioles and pedicels loosely villous; calyx densely villous; keel distinctly curved.

CALIFORNIA. Santa Cruz Island: Apr., 1888, *T. S. Brandegee* (TYPE, UC 82003).

Mounted on the sheet with the above specimen are some small plants (UC 82002) collected by Brandegee at San Telmo, Lower California, 28 Apr., 1893. These may represent the variety *insularis*, but should prove to be different. They are so small and in such condition I prefer to attempt no definite classification of them at this time.

4*g*. **Lupinus subvexus phoeniceus** var. nov. [FIG. 13.]

Eramosus vel ad basin laxe ramosus, ramis ramulosis laxe breve-villosis: verticillis 2–5 vel plus, appositis vel distantibus; floribus ad anthesin pandentibus, postea ascendentibus vel suberectis, 12 mm. longis; calyce ebracteolato, 7 mm. longo, subter paulo laxe villoso, pilis 1–1.5 mm. longis, paulo retrorsis, labio superiore minus 2 mm. longo, inferiore lanceolato-oblongo, vix 3 mm. lato, 2-dentato dentibus 1 mm. longis parallelis plerumque dentis vestigio instructo; corolla phoenicea vel pallidiora; vexillo 10–11 mm. longo, 6 mm. lato, apice angulato; alis 9 mm. longis ad basin superne paulo ciliatis; carina 8 mm. longa, plerumque recta: leguminibus 13 x 7 mm.; seminibus planis angulatis, 5 mm. longis, 4 mm. latis, atro-cineraceis, minute nigromaculatis circum cicatricula pallidioribus, superficie minute inaequaliterque rugoso simile quartzo.

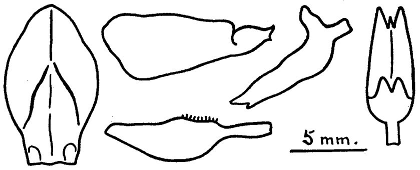

Fig. 13. Lupinus subvexus phoeniceus C. P. Smith. *A. A. Heller 8632* (US 612641).

Simple or loosely branched from near the base, loosely short villous; whorls usually two to five, crowded or distinct; flowers spreading in anthesis, soon becoming suberect, about 12 mm. long; calyx retrorse-villous below with hairs 1–1.5 mm. long, the lower lip with a vestigial median tooth; petals reddish purple or paler, the banner about 10 x 6 mm., angled at the apex; seeds 5 x 4 mm., somewhat flattened and angled, dark-gray, minutely dotted with black, paler about the hilum, the entire surface minutely roughened, resembling quartz.

California. Santa Clara County: Mt. Hamilton road, 2300 ft. alt., "on a roadside bank near oak trees," 31 May, 1907, *A. A. Heller 8652* (Type, US 612641; type-duplicates, PA, NY, G); seed only, type locality proper, 17 June, 1908, *C. P. Smith* (CPS); tilled soil below Smith Creek bridge, 17 June, 1908, *C. P. Smith 1479;* Calaveras Valley, May, 1914, *K. Brandegee* (UC 178195, except as to raceme in upper left hand corner).

This seemingly well-marked variety may be peculiar to the Mt. Hamilton Range. The plants are low and mainly simple in poor soil, but in richer and looser soil may be 2–3 dm. tall with a spread of 3–4 dm. The Smith Creek specimens were in seed as to the primary branches, while secondary branches, in the axils of the primary branches, were in flower..

Probably related to this, but certainly not typical, are the following: Atascadero, San Luis Obispo County, 30 Apr., 1861, *W. H. Brewer 493* (US); Ojai and vicinity, Ventura County, 24 May, 1866, *Peckham* (US). Additional material from these localities would be welcome and worthy of careful study.

The type collection has been recorded as *L. microcarpus* by Heller (Muhlenbergia **2**: 294. 1907).

Phoeniceus is Latin for "purple-red."

4*h*. **Lupinus subvexus albilanatus** var. nov. [FIG. 14.]

A var. *phoeniceo* differt foliis gracillimis acutis plurimum solum 10–20 mm. longis; foliis petiolis pedunculisque conspicue brevilanato-villosis; vexillo 12–14 mm. longo, graciliore; seminibus plurimum minoribus pallidioribus, immaculatis vel maculatis.

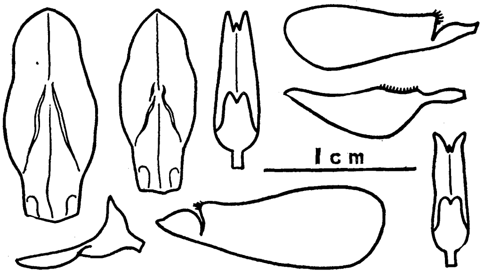

FIG. 14. LUPINUS SUBVEXUS ALBILANATUS C. P. Smith. *K. Brandegee* (UC 149886).

CALIFORNIA. San Luis Obispo County: Paso Robles, July, 1911, *K. Brandegee* (TYPE, UC 149886; type-duplicates, UC 149884, 149885, and 149947). Monterey County: near Plaskett's ranch, on road to Jolon, about seven miles from Kings City, *K. Brandegee* (UC); Manfield's ranch, Santa Lucia Mountains, ten miles from Kings City, 1–12 May, 1897, *A. Eastwood* (G).

This variety is conspicuous for its whitish cast and the narrowness of its banner. The seeds are variable in size and color, as shown by Mrs. Brandegee's collections. Those with sheet 149884 are about 5 x 4 mm., some milky- or bluish-white unmarked with the hilum area flesh-color, while others are drab with an occasional dark speck and a conspicuous bluish-white or pale area about the scar. Those with sheet 149885 are 4 x 3 mm. with a drab ground much speckled with black, the hilum area little or conspicuously paler and unspotted. Those with sheet 125917

(Monterey County) are 4 x 3 mm., heavily marbled with dark-brown, the hilum area unmarked and pale. The variety is evidently confined to the upper Salinas Valley.

Albilanatus is Latin for "white-woolly," which is descriptive of the general pubescence in this plant.

4*i*. **Lupinus subvexus Wilkesii** var. nov. [FIG. 15.]

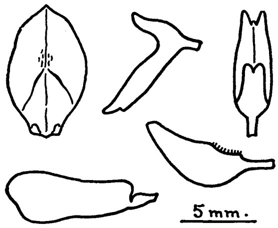

FIG. 15. LUPINUS SUBVEXUS WILKESII C. P. Smith. *Capt. Wilkes* (US 20841).

A var. *phoeniceo* differt verticillis confertis et carina curva: caulo plus minusve erecto, 20–30 cm. alto, gracili aliquantum super basin ramoso, laxe villoso pilis 1 mm. longis; petiolis gracillimis 5–8 cm. longis; foliolis 7–9, oblanceolato-spatulatis prope 15 mm. longis; pedunculis folia aequantibus, laxe villosis; verticillis prope 8, inferioribus distantibus, superioribus confertis; floribus 9–10 mm. longis ad anthesin pandentibus mox postea suberectis; pedicellis gracillimis; bracteis prope 5 mm. longis mox reflectentibus; calyce 7–8 mm. longo, labio inferiore 2-dentato, sinu dentis vestigio instructo: legumina et semina non vidi.

CHILE. Valparaiso, *Capt. Wilkes*, U. S. Explor. Exped. (TYPE, US 20841).

The specimen is labelled "*L. microcarpus*, var.," but is so different from all other Chilean material seen by me that I think it best to set it apart as a variety of *L. subvexus*. The flowers become suberect soon after anthesis and have several characters in common with var. *phoeniceus*, but this differs in the greater number of whorls, more crowded above, in the very slender pedicels, and in the curved keel.

5. LUPINUS LUTEOLUS Kell. Proc. Cal. Acad. Sci. **5**: 38. 1873. [FIG. 16.]

Lupinus Bridgesii Gray; Watson, Proc. Am. Acad. **8**: 538. 1873.

From Kellogg's description I quote:

> Stem 1–2 feet high, suffruticose, glabrous below, bark light creamy hue, satiny fibrous; numerously branched toward the top, forming a very symmetrical rather wheel-shaped cone. . . . Leaflets . . . silky above and below. . . . Flowers light yellow . . . in a dense crowded spike 6 to 12 inches in length . . . calyx tube scarious, very short and widely gaping, 2-bracteolate . . . upper lip ovate-lanceolate, acute, entire; lower lip herbaceous, 3-toothed, slightly deflexed and subsaccate at the junction of the scarious portion . . . wings broad and somewhat inflated, glabrous, with scarcely

a few hairs on the margin at the base; keel acute, villous on the margins above at the lower third. . . .

Found on the Coast range of mountains, near Senal, Mendocino County, Cal. 1872.

From Watson I quote:

> Stem 1–2 feet high . . . leaflets . . . pubescent both sides or somewhat smooth above . . . petals pale yellow. . . .
>
> Sacramento Valley. Collected by Bridges (55), Bolander (6512), and Dr. Kellogg.

Jepson (Fl. West. Mid. Cal. 2d ed. 216. 1911) emphasizes the "herbaceous" character of the upper calyx-lip.

As shown by my drawings, I have made studies of dissected flowers from specimens taken at five different stations, representing the geographical range of the species. I also studied with a lens several others of the specimens listed below. Only one specimen evidently supports the claim for an herbaceous upper lip, and just three sheets plainly show bracteoles present. The banner is usually ovate, acute, with the claw distinct and stiffened. The wings are sometimes strongly ciliate at the base below, as well as above, and the keel seems to be generally as densely ciliate below as above, the ciliation extending well out onto the slender claw. The upper lip of the calyx is sometimes emarginate and

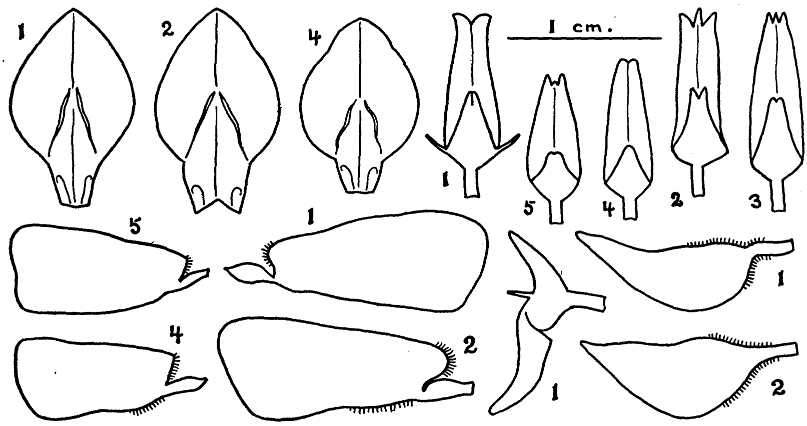

FIG. 16. LUPINUS LUTEOLUS Kell. 1. *A. Eastwood*, Mendocino County (US 468711); 2. *H. N. Bolander 6512* (US 321126); 3. *F. P. Nutting*, Contra Costa County (UC 15918); 4. *J. P. Tracy 3496*, Humboldt County (US 542773); 5. *M. W. Gorman 411*, Oregon (US 280475).

the lower lip is sometimes two-toothed. The seeds are about 4 x 3.5 mm., uniformly dark brown, regularly and roughly tuberculate as to the specimens seen.

CALIFORNIA. County not given: *Bridges 55* (T); 1866, *H. N. Bolander 6512* (US); head of Penn Creek, 5100 ft., Aug., 1875, *J. T. Rothrock 224* (US); near Cheswick, 30 July, 1899, *J. B. Leiberg 4318* (US). Contra Costa County: Fish Ranch, 29 June, 1893, *F. P. Nutting* (UC); Walnut Creek, 28 July, 1897, *Mrs. T. J. Maynard* (UC). Lake County: Lakeport, 16 Aug., 1882, *C. G. Pringle* (US); Allen's Spring, 6 July, 1882, *D. Cleveland* (UC); between Potter Valley and Hullville, 21 July, 1902, *A. A. Heller 5938* (US, CPS); Scott Valley, 21 Aug., 1905, *J. P. Tracy 2372* (UC); Kelseyville, 2 July, 1911, *K. Brandegee* (UC); Kelseyville, July–Aug., 1892, *W. L. Jepson* (UC); between Houghs and Bartlett Springs, 11 Aug., 1910, *K. Brandegee* (UC); Sanhedrin, June, 1894, *Purpus 1132* (UC); Mt. Sanhedrin, 18 July, 1913, *H. M. Hall 9514* (UC). Mendocino County: Covelo, 20 July–3 Aug., 1897, *V. K. Chesnut 543* (US); Cloverdale, Russian River, 9 July, 1902, *A. A. Heller 5830* (US); Calito, 5 Aug., 1902, *A. Eastwood* (US). Humboldt County: valley of Trinity River, near mouth of Willow Creek, 10 July, 1911, *J. P. Tracy 3496* (US); valley of Van Duzen River, opposite Buck Mountain, 27 June–30 July, 1908, *J. P. Tracy 2696* (US, UC); Kneeland Prairie, 26 July, 1912, *J. P. Tracy 3871* (UC); Eel River, July, 1894, *Purpus 1206* (UC). Shasta County: near Middle Creek station, 3 June, 1905, *A. A. Heller 7951* (US). Siskiyou County: Klamathon, 2 July, 1903, *E. B. Copeland*, Baker Distribution 3535 (US); Yreka, 8 June, 1905, *A. A. Heller 7990* (US); Hornbrook, July, 1887, *K. Brandegee* (UC); dry land near Yreka, June, 1908, 1909, 1910, *Butler 375, 910, 1447* (UC).

OREGON. Jackson County: Rogue River Valley, 14 July, 1887, *T. Howell* (UC); Ash Creek, near Ashland, July, 1893, *Mrs. R. M. Austin* (UC); Ash Creek, Rogue River Valley, July, 1893, *Mrs. Austin* (UC); Medford, 25 Aug., 1897, *Mrs. Austin 1651* (US); Spouting Springs, thirteen miles south of Ashland, 13 Aug., 1896, *M. W. Gorman 411* (US). County not given: Dead Indian road, western slope Cascades, 12 Aug., 1902, *W. C. Cusick 2945* (US).

COLLEGE PARK,
MARYLAND